# ECONOMIC RURAL LANDSCAPING THROUGH ESTABLISHMENT OF NATIVE PLANTS

## A Roadside Development Summary Report

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

and

THE MONTANA DEPARTMENT OF HIGHWAYS

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# TABLE OF CONTENTS

Page
INTRODUCTION . . . . . . . . . . . . . . . . . . . . . . . . . . 1

DRYLAND TUBELING TRANSPLANTING . . . . . . . . . . . . . . . . . 1

MATURE TREE TRANSPLANTING . . . . . . . . . . . . . . . . . . . 7

NATIVE SHRUB TRANSPLANTING . . . . . . . . . . . . . . . . . . 11

CONCLUDING STATEMENT . . . . . . . . . . . . . . . . . . . . . 15

REFERENCES. . . . . . . . . . . . . . . . . . . . . . . . . . . 16

# INTRODUCTION

Tree and shrub plantings included in roadside development plans can improve long-term road stability and aesthetics. Trees and shrubs stabilize roadside materials by reducing temperature fluctuations, wind velocity, raindrop impact, and soil erosion. These positive benefits of planting woody vegetation have been recognized for many years, however, most highway departments have experienced difficulty establishing desired stands of these species. Furthermore, shrub and tree development problems have been amplified in the semiarid west because of erratic precipitation patterns. These vegetative establishment problems encouraged the Federal Highway Administration, Montana Department of Highways and the Montana Agricultural Experiment Station to develop more reliable and efficient methods of establishing desired types of woody vegetation.

Studies were implemented to introduce trees and shrubs in roadside areas already stabilized with perennial grasses. Efforts were concentrated on perfecting methods to overcome the problems associated with efficiently establishing limited numbers of large trees and numerous small slow growing plants in highly competitive environments where soil moisture is generally limiting.

# DRYLAND TUBELING TRANSPLANTING

Developments in the establishment of woody plant species utilizing small individual plant containers have attracted much attention in recent years. Of the many containerized planting systems developed, each uses containers which vary in material, size and shape. Plant material size and handling methods also vary widely. Early containerized systems were developed to enable efficient

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planting of large numbers of small plants for reforestation or similar projects. These systems have generally proven unreliable when used in harsh environments such as semiarid roadsides.

During the early 1970's the Montana Agricultural Experiment Station, Montana Department of Highways and Federal Highway Administration initiated research to develop a planting container specifically for establishing trees and shrubs in harsh, semiarid roadside environments. A planting system was ultimately designed to facilitate planting of one to two-year old plant stock with well developed root systems that could be positioned at least two feet below the soil surface. (Photo 1).

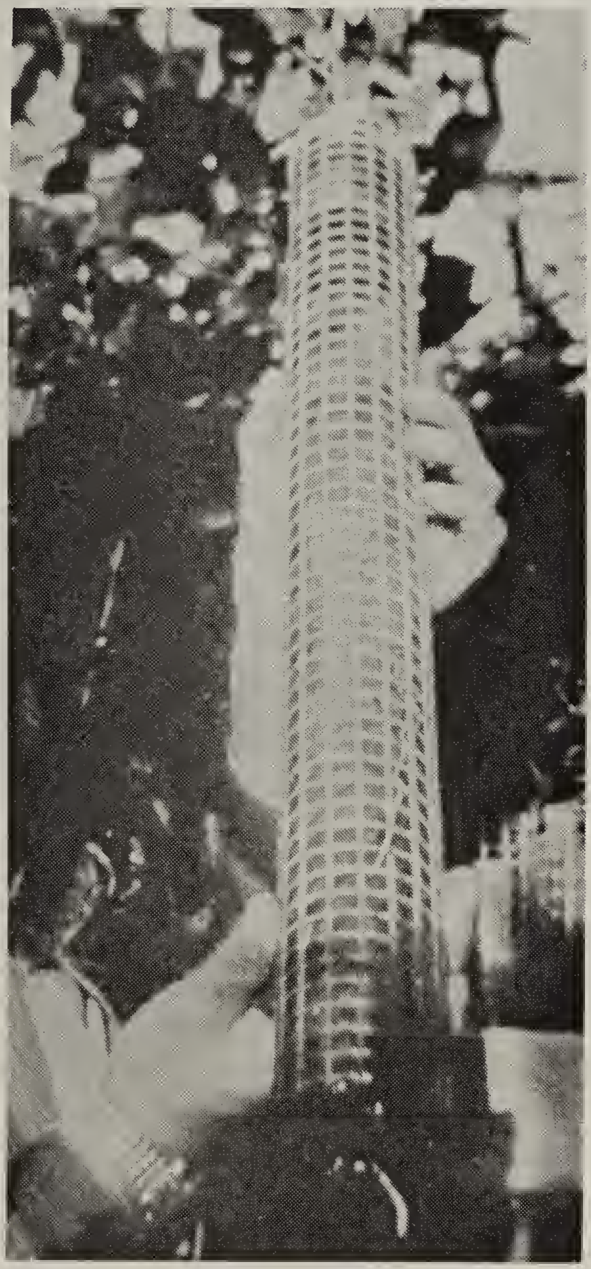

Photo 1. The final container design selected for the dryland tubeling planting method.

This first tubeling produced by commercial plastic and paper products manufacturers consisted of a 2.5 inch outside diameter by 24 inch long, 2-ply circular tube constructed of highly absorbent paper. The paper tube was inserted inside a similarly sized polyethylene mesh sleeve of semiridged construction for tubeling support in handling and storage. The 2-ply paper tube liner was coarse in texture, absorbent and designed to decompose readily after planting in the field, thus allowing roots to easily penetrate into the surrounding soil.

After three years of growth, tubeling performance was rated excellent in almost all categories but excavation of tree root systems revealed the polyethylene mesh was not degrading and had restricted root growth of several species (Photo 2). This potential problem was solved through removal of the mesh before planting or by using degradable plastic in place of the polyethelene.

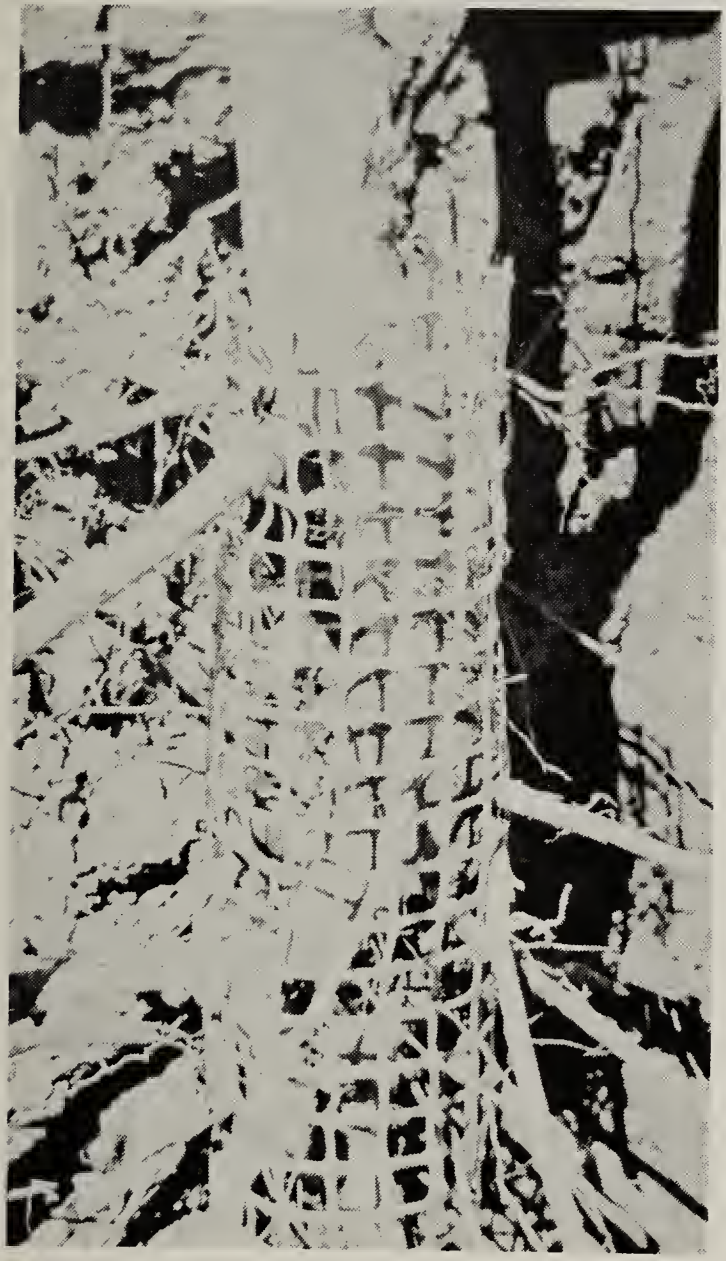

Photo 2. The polyethylene mesh used in the first tubelings restricted root growth, consequently it was replaced with a biodegradable plastic.

Additional development in cooperation with manufacturing companies is being continued to produce a biodegradable, low cost, optimum performance tube. During the period of tubeling development, planting and handling techniques were evaluated. Wooden racks were designed and constructed to hold 24 tubelings in an upright position thus facilitating handling and transportation.

Plants may be established out-of-doors if desired. This method eliminates the need for expensive greenhouse facilities and reduces labor requirements, but adds to the required plant growth period. It must be realized that in northern climates, the equivalent of a 2 to 4 year old tree can be greenhouse grown in 8 to 10 months (Photo 3).

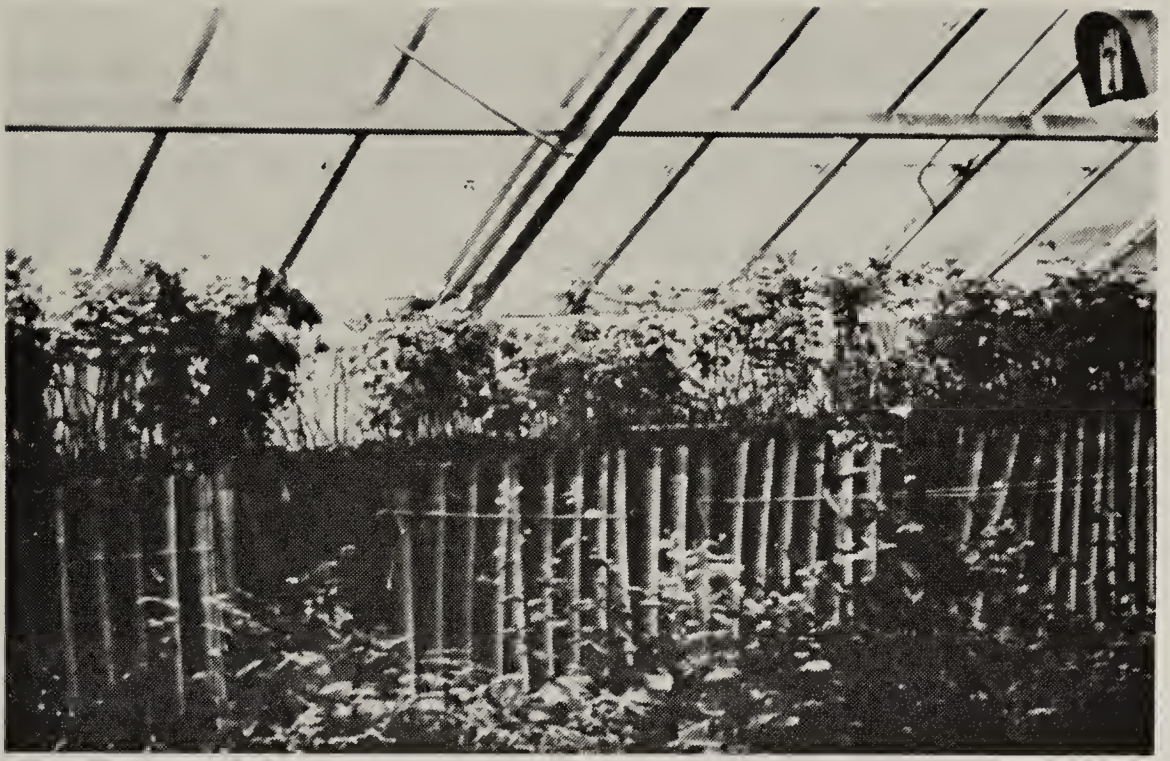

Photo 3. In the northern climates the equivalent of a 4-year old tree can be greenhouse grown in 8 to 10 months.

If plants are grown in a greenhouse or other protected environment it is important that the plants be "hardened" before being planted in the field. The "hardening" period requires that plants be placed in a lathhouse or other suitable semiprotected outdoor location for a period of two to three weeks, allowing the plant to gradually adjust to the more harsh outdoor environment.

Specific plant growth periods and methods depend entirely upon the species grown, season of field planting and objectives of the planting. More specific information with regard to the foregoing can be obtained from Montana State University or by referring to Montana State University Agricultural Experiment Station Research Report 141, Volume 2 (Jensen and Hodder, 1979).

Originally, planting holes were augered with small gasoline powered portable augers which proved to be labor intensive (Photo 4). Recently, significant advances have been made in the mechanization of tubeling planting. The latest automatic dryland tubeling planter developed by Montana State University and the Vegetative Rehabilitation and Equipment Workshop is capable of augering a two foot deep planting hole, positioning a tubeling plant in the hole, backfilling and compacting the soil around the plant in less than one minute. The dryland tubeling planter is a reliable machine capable of planting on any terrain a

three point hitch equipped tractor can tranverse. Development of the dryland tubeling planting system and a high production rate planting machine has made it economically feasible to plant large numbers of shrubs and trees on semiarid roadsides with greater assurances of attaining acceptable plant establishment rates (Photos 5 & 6).

Photo 4. Small gasoline powered portable augers can be used for augering planting holes.

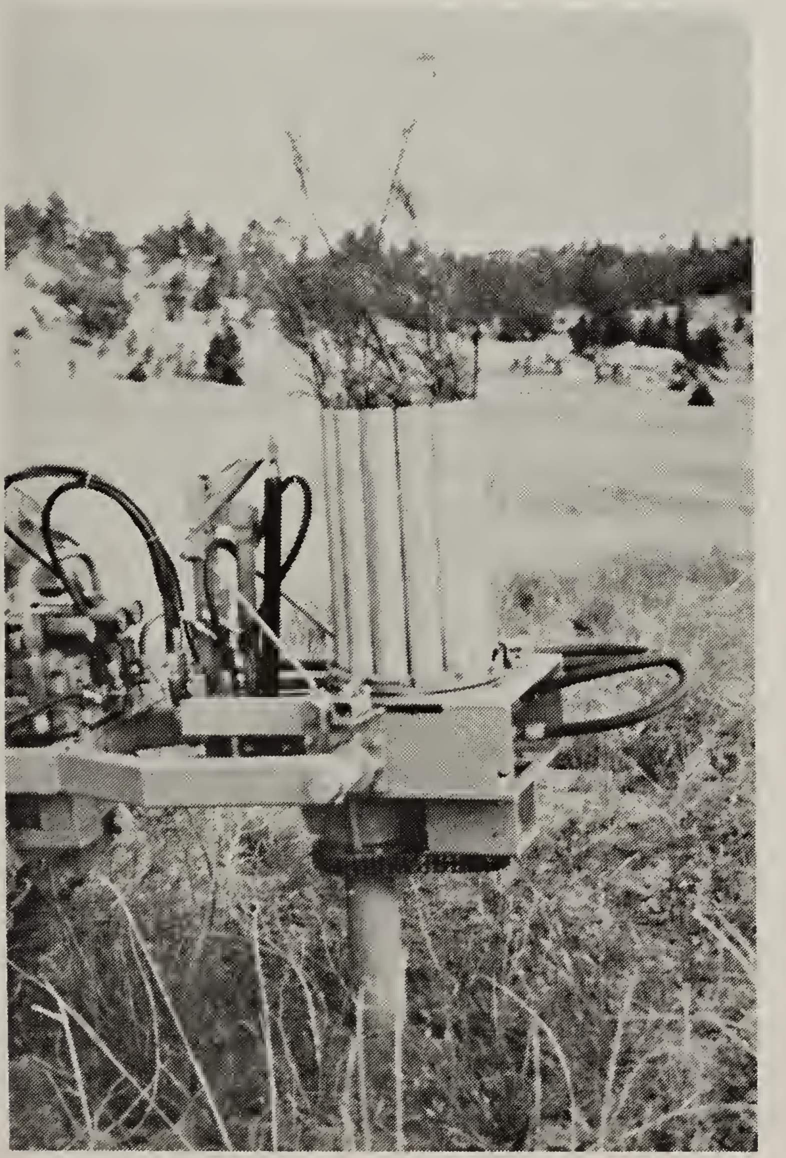

Photo 5. The automatic tubeling planter allows rapid planting of 24 inches long dryland tubelings.

Photo 6. The automatic tubeling planter augers a 10-inch diameter hole, positions a tubeling in the hole and compacts the excavated soil around the tubeling as the auger backs out of the hole.

The following list of plants have been successfully planted in Montana using the dryland tubeling planting method. In comparison to bare root stock 25 to 50 percent increases in survival rates during the first three years of growth have been recorded.

| Common Name | Scientific Name |
|---|---|
| Mountain snowberry | *Symphoricarpos oreophilus* |
| Antelope bitterbrush | *Purshia tridentata* |
| Ponderosa pine | *Pinus ponderosa* |
| Hanson hedgerose | *Rosa hansoni* |
| Stansbury cliffrose | *Cowania mexicana* |
| Siberian salt tree | *Halimodendron halodendron* |
| Peach tree | *Prunus fasiculata* |
| Squaw apple | *Peraphllum ramosissimum* |
| Oldman wormwood | *Artemisia abrotanum* |
| Rocky Mountain juniper | *Juniperus scopulorum* |
| Sea buckthorn | *Hippophoae rhamnoides* |
| Nanking cherry | *Prunus tomentosa* |
| Skunkbush sumac | *Rhus trilabata* |
| Chokecherry | *Prunus spinosa* |
| Honeysuckle | *Lonicera tatarica* |
| Native plum | *Prunus americana* |
| Western white clematis | *Clematis limgusticifolia* |
| Canadian clematis | *Clematis tangutica* |
| Sandcherry | *Prunus bessyii* |
| Creeping juniper | *Juniperus horizontalis* |

## MATURE TREE TRANSPLANTING

Roadside and rest area aesthetics can be significantly and immediately improved by the successful transplanting of large trees common to the surrounding landscape. Highway right-of-way clearing activities frequently destroy mature well developed trees and shrubs. Follow-up landscaping projects usually include only the planting of numerous small nursery produced plants which often require ten years, or more, to develop into significant sized plants.

One method of achieving pleasant roadside landscapes is through the utilization of the modern tree spade. Recent developments have made the tree spade a highly mobile, efficient, large capacity transplanting machine (Photo 7).

Photo 7. The modern tree spade has made possible the transplanting of large well developed trees and shrubs.

Numerous studies and plantings were completed in Montana to evaluate the practicality of the large tree spade and to develop improved operation guidelines. The five mature trees commonly transplanted in Montana are as follows:

| Common Name | Scientific Name |
|---|---|
| Ponderosa Pine | *Pinus ponderosa* |
| Rocky Mountain juniper | *Juniperus scopulorum* |
| Russian olive | *Elaeagnus angustifolia* |
| Boxelder | *Acer negundo* |
| Plains cottonwood | *Populus deltoides* |

Initial transplanting research conducted by Montana State University relied upon a trailer mounted four-blade tree spade designed to plant trees with diameters up to four inches. Maximum root ball size for these trees was 44 inches in diameter and 40 inches deep. Large distances between tree salvage sites and planting locations often required the wrapping of root balls and transporting on trailers (Photo 8). This labor intensive procedure was neither economic nor conducive to tree survival. Through the efforts of the Vegetative Rehabilitation and Equipment Workshop an efficient tree excavation, transporting and planting system has been developed.

Photo 8. Due to great distances between salvage and planting locations, trees had to be taken out of the tree spade, wrapped with burlap and transported on trailers.

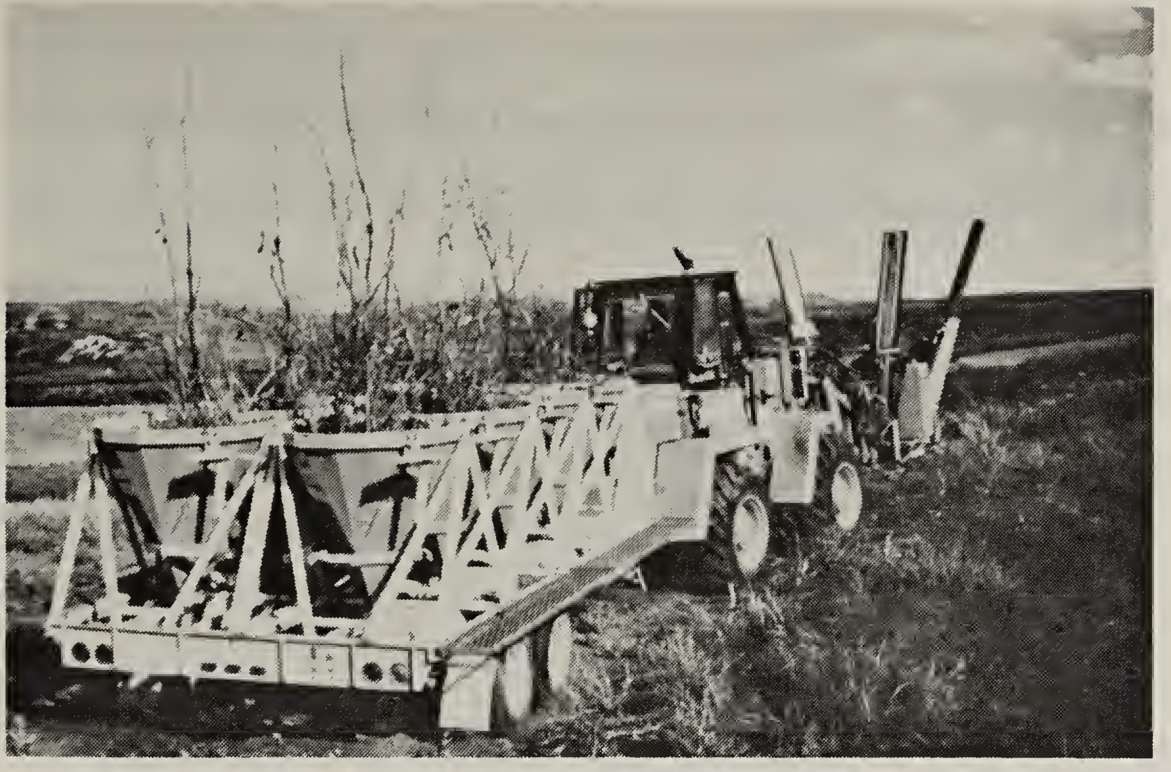

Photo 9. Tree transplanting efficiency has been greatly improved by the development of a special tree spade mount and an efficient tree transporting trailer.

This system is comprised of a large four-wheel drive tractor with a tree spade attached to it's front-end loader which pulls a special tree transporting trailer (Photo 9). Up to eight trees can be excavated and placed directly into specially designed metal containers mounted on the trailer. At the planting site the front-end loader mounted tree spade lifts each tree out of its container and places it into the prepared planting hole (Photo 10).

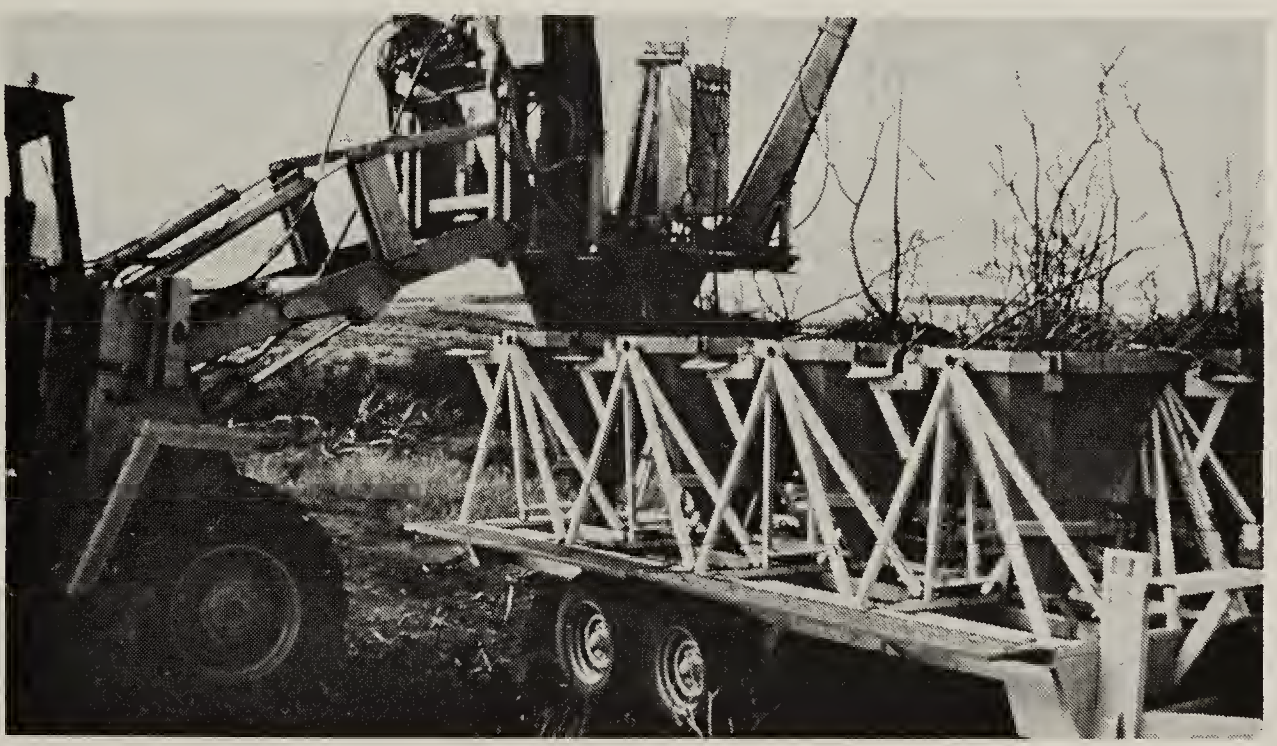

Photo 10. At the planting site the front-end loader mounted tree spade is used to move the trees from the transport containers to the planting holes.

When salvage and planting locations were not separated by extreme distances, a tree spade mounted directly on a heavy duty truck was used. The truck mounted spade proved to be much more efficient in that it could be positioned accurately, was easy to manuever in minimum clearance situations and could travel rapidly from one location to the next (Photo 11).

Photo 11. A tree spade mounted directly on a heavy duty truck was more efficient to operate than a trailer mounted tree spade.

Mature tree survival rates were highly dependent upon the size of tree transplanted. Trees which approached or exceeded the rated tree spade capacity had significantly lower survival rates. Trees salvaged from moist protected sites and planted in more harsh environments underwent high mortality rates even though the species were rated as hardy and easy to transplant. Maximizing the ratio of root ball size to tree size increased tree survival and vigor.

# NATIVE SHRUB TRANSPLANTING METHOD

Many species of native shrubs normally destroyed during right-of-way clearing operations can be easily tranplanted to stabilize erosive drainage areas or for landscaping purposes. The salvageable shrubs have taken many years to attain their mature size and this valuable resource should be used rather than destroyed.

The cost of planting individual nursery grown shrubs is prohibitive if large masses of plants are to be established. Furthermore, it takes four or five years for two-year old shrub stock to develop into useful sized plants in the environment of Eastern Montana. The direct seeding of shrubs has proven to be extremely difficult and if seeded shrubs do germinate and emerge, growth rates are very slow.

Research has evaluated two methods of salvaging and re-establishing rhizomatous root system shrubs. One method is referred to as rootpad transplanting. It involves preparing a shrub pad for transplanting by first mowing the shrubs to within approximately four inches of the soil surface. A large capacity front-end loader is used to prepare a planting depression to receive the root pad. The loader then removes the root system from the soil by scooping at a depth of approximately 12 inches under the rootpad until the bottom of the bucket is covered. The shrub pad is lifted and transported to the planting site. The bucket is gradually tipped as the loader moves backward sliding the rootpad off the bucket and into the planting depression (Photo 12).

Following unloading of the shrub rootpad, topsoil is filled in around the edges of the pad and into all cracks that developed while unloading. Rootpad transplanting establishes masses of shrubs such as pad of snowberry and

rosebush shown in Photo 13 within one year of transplanting. The rootpad method is an appropriate technique for landscaping around rest areas or for establishing erosion resistant revegetation in drainage ditches.

Photo 12. A large front-end loader is used to excavate and transport a 12-inch thick section of shrub root systems to a new planting site.

Photo 13. Transplanting of rhizomatous shrub root systems establishes masses of mature sized plants within one year.

A second method of transplanting rhizomatous root system shrubs is referred to as root sprigging. This method was developed to transplant rhizomatous root systems that can be disturbed or harvested separate from the soil and then spread uniformly over large areas. Root sprigging is generally used for establishing large areas of low density plants rather than individual groupings of shrubs.

The first step in root sprigging is to locate a dense stand of the desired shrub species and removing the top growth to within four inches of the soil surface. The remaining top growth and rhizomatous root systems are then excavated with an agricultural type plow or similar implement and a front-end loader. No effort is made to keep the roots and soil consolidated (Photo 14). The root-soil mixture is then transported by dump truck to the planting site where it is uniformly spread over the planting area. The root systems are then completely covered with approximately four inches of good quality topsoil.

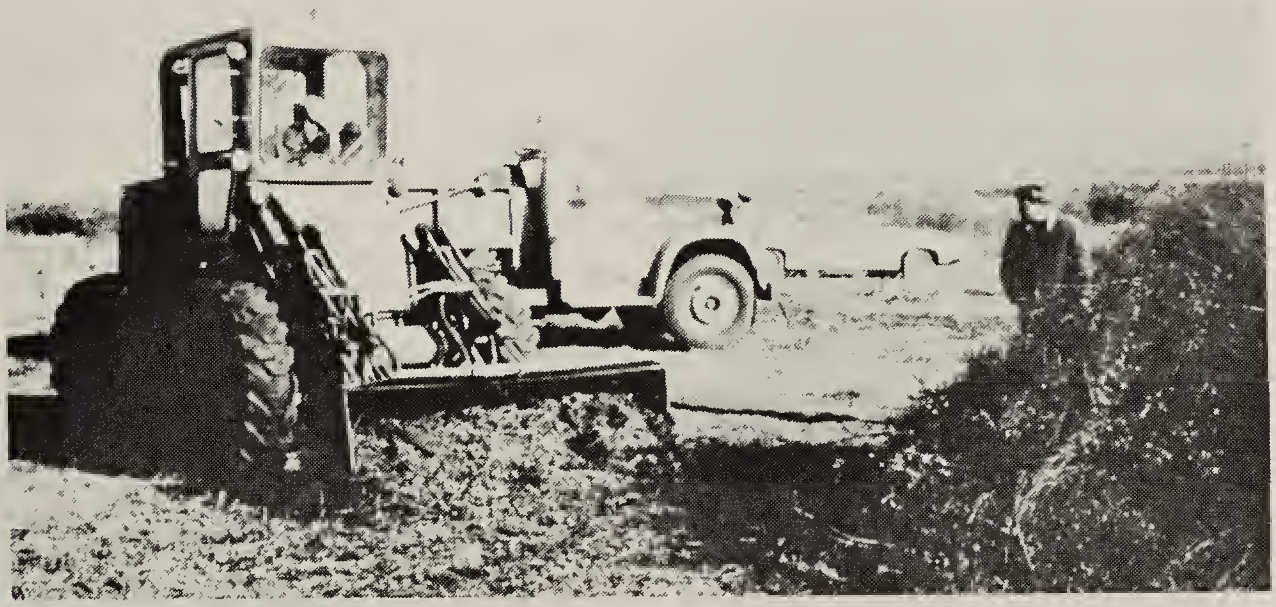

Photo 14. Root systems with the top growth removed are excavated with a front-end loader and transported to the planting site.

This root sprigging method has proven to rapidly establish excellent stands of shrubs such as wild rose, snowberry and sages common to many roadsides and mine sites. (Photo 15).

Photo 15. The highly disrupted rhizomatous root systems covered with soil rapidly emerge and form a fast developing shrub cover.

An improved shrub sprigging machine is presently being developed by Montana State University, Reclamation Research Unit and the Vegetative Rehabilitation and Equipment Workshop. This machine, a modified heavy duty potato picker, separates root systems from the soil before loading (Photo 16). The root systems are loaded directly into a modified manure spreader which is used to transport and uniformly spread the roots over the planting area. A scraper then covers the root systems with six inches of topsoil. This method can be implemented using commonly available construction equipment and the more recently developed root harvesting machines. Use of this technique should prove useful for rapidly stabilizing critical drainage areas with an erosion resistant stand of shrubs.

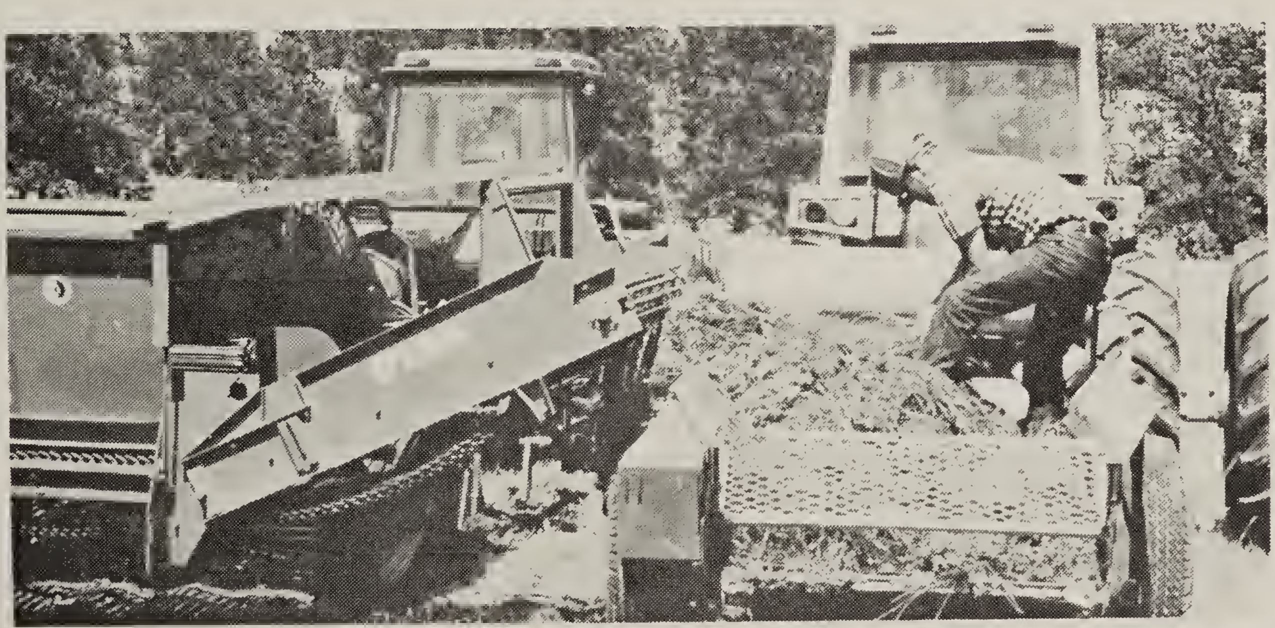

Photo 16. A special machine is presently being developed to enable the efficient harvest of large volumes of native shrub root system for transplanting.

# CONCLUDING STATEMENT

The research summarized on the previous pages of this report is more fully covered in volumes 1, 2 and 3 of Research Report 141 from the Montana Agricultural Experiment Station. These publications are available from Montana State University, Bozeman, Montana 59717. Related materials are recorded on 35 mm slides with taped audio presentations. These may be obtained from Federal Highway Administration Regional Offices.

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Jensen, I.B. and R.L. Hodder. 1979. Rapid soil stabilization and perennial vegetation establishment with use of annual species, irrigation and seedbed treatments. Mont. Agric. Exp. Sta. Mont. State Univ. Research Report 141, V1. Bozeman. 80 pp.

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